Space Weather Technical Forecast

Issued on Tuesday, 16 January 2024 at 13:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at Low levels, with only C-Class activity recorded. There are currently twelve sunspots on the visible disc, three of which remain unnumbered. AR3541 in the southwest has seen some simplification over the last 24 hours, with the number of spots in the intermediate region appearing to decrease although likely in some part a function of the increasingly oblique viewing angle. AR3549 still consists of a large leader spot, with the region as a whole continuing to display some magnetic complexity. The recently numbered AR3555 continues to rotate onto the disk in the southeast. Full analysis of this spot remains difficult due to foreshortening. All other regions appear to be stable, or in decay.

No CMEs observable on coronagraph imagery over the past 24 hours are expected to have an Earth-directed component.

Solar Wind / Geomagnetic Activity: As the US SWPC reports, persistent peak tracking errors on DSCOVR's faraday cup instrument continued to make accurate measurements of the solar wind parameters difficult. When peak track tracking seems most reliable, solar wind parameters are near background levels averaging near 350 km/s. Density has been around average or below, though low confidence in this parameter. The interplanetary magnetic field (IMF), Bt, has been generally weak throughout, but with a peak recorded into moderate levels around 15/1845UTC. The north-south component, Bz, was weak and mostly negative, fluctuating between +4/-6nT. Phi angle was persistently negative (toward the Sun) until around 16/0300UTC, after which point it became not strongly aligned either way. Geomagnetic activity was mostly Quiet (Kp 0-2), with a brief interlude of unsettled (Kp3) 16/0000-0300.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels.

GOES16 high energy (greater than 2MeV) electron flux was at background to moderate levels. The associated 24-hour fluence was well below Active (1e8 integrated pfu) throughout. The 16/0000 UTC 24-hour integrated fluence observation was 1.45e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of isolated M-class activity throughout, and a very slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

The high speed stream of CH92/+, with potential speeds of 450-500 km/s, expected to influence the near Earth environment day 1 (16 Jan) into day 2 (17 Jan), with the effects waning into the period and just the small chance of further coronal hole influence by the end of day 4 (19 Jan).

Overall, geomagnetic activity is likely to be Quiet (Kp 0-2), but with a chance of Unsettled to Active (Kp 3-4) intervals days 1 or 2 (16-17 Jan) should we see any HSS influence from CH92/+, with this risk returning into day 4 (19 Jan).

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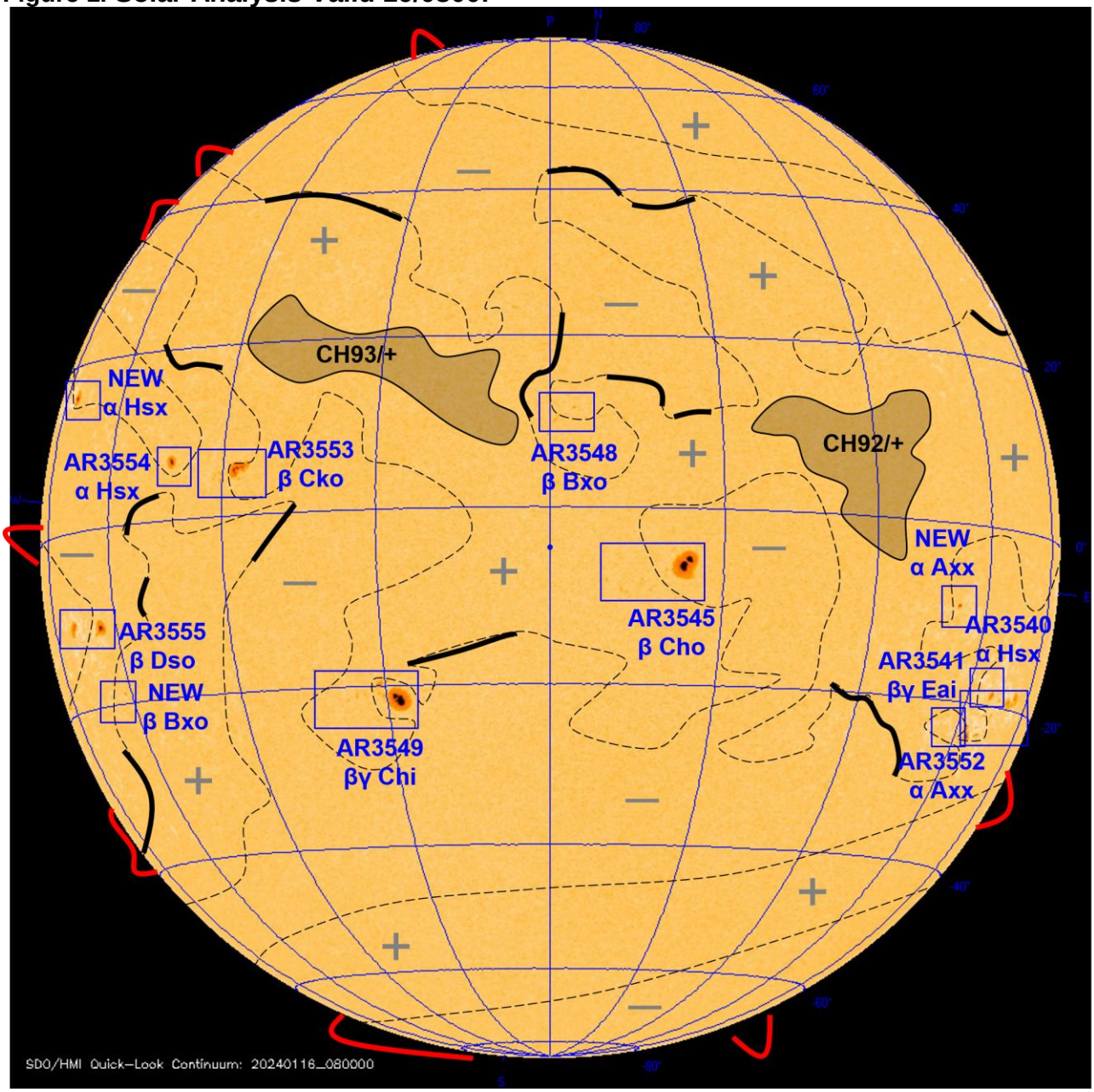
Energetic Particles / Solar Radiation: High energy proton flux will most likely remain at background levels. Although, there remains an ongoing slight chance of seeing an increase to the S1/Minor Radiation Storm threshold should any notable flares occur.

The high energy electron flux is forecast to persist at generally background to moderate levels, with fluence below the Active threshold through the period.

Figure 1. Solar Analysis Valid 16/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs currently feature in the forecast.

Solar wind speeds are expected to remain at slow-ambient levels into the start of day 1 (16 Jan). The main feature of interest in the forecast period is CH92/+, currently in the northwestern quadrant. This coronal hole is a persistent feature, but is smaller and with a leading edge further east than last rotation. Wind speeds in the High Speed Stream (HSS) reached above 600 km/s on the previous rotation. However, the much reduced size of the coronal hole suggests likely somewhat slower wind speeds, perhaps reaching 450-500 km/s, which combined with the change in position, give a potential arrival time later day 1 (16 Jan) or perhaps into day 2 (17 Jan). This feature then expected to wane into the period with the current enhancement signaled by ENLIL output into the 19 Jan tentatively associated with CH93/+ in the northeast and thought somewhat too early.

Overall, geomagnetic activity is likely to be largely Quiet (Kp 0-2). There is a chance of Unsettled to Active (Kp 3-4) intervals from day 1 into day 2 (16-17 Jan) upon connection to the anticipated coronal hole HSS, with a similar risk into day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X-Ray Flares:

AR3541 remains the active region with the greatest assessed flare risk currently, it has seen some simplification over the last few hours however with the number of spots in the intermediate region appearing to decrease, although likely in some part a function of the increasingly oblique viewing angle. This region expected to leave the visible disk later day 2 into day 3 (17-18 Jan). AR3549 in the southeast still consists of a large leader spot, with its trailing spots showing some minor growth and complexity and remains a watch point.

Seismic far-side analysis and recurrence would suggest that one or more regions may return or rotate across the eastern limb through the period, this perhaps going someway to maintaining flare risk following the loss of the AR3541 complex.

Therefore a chance of isolated M-flares is maintained throughout, with a very slight chance of isolated X-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: Imagery valid 16/0000UTC for the AR3441/40/52 complex

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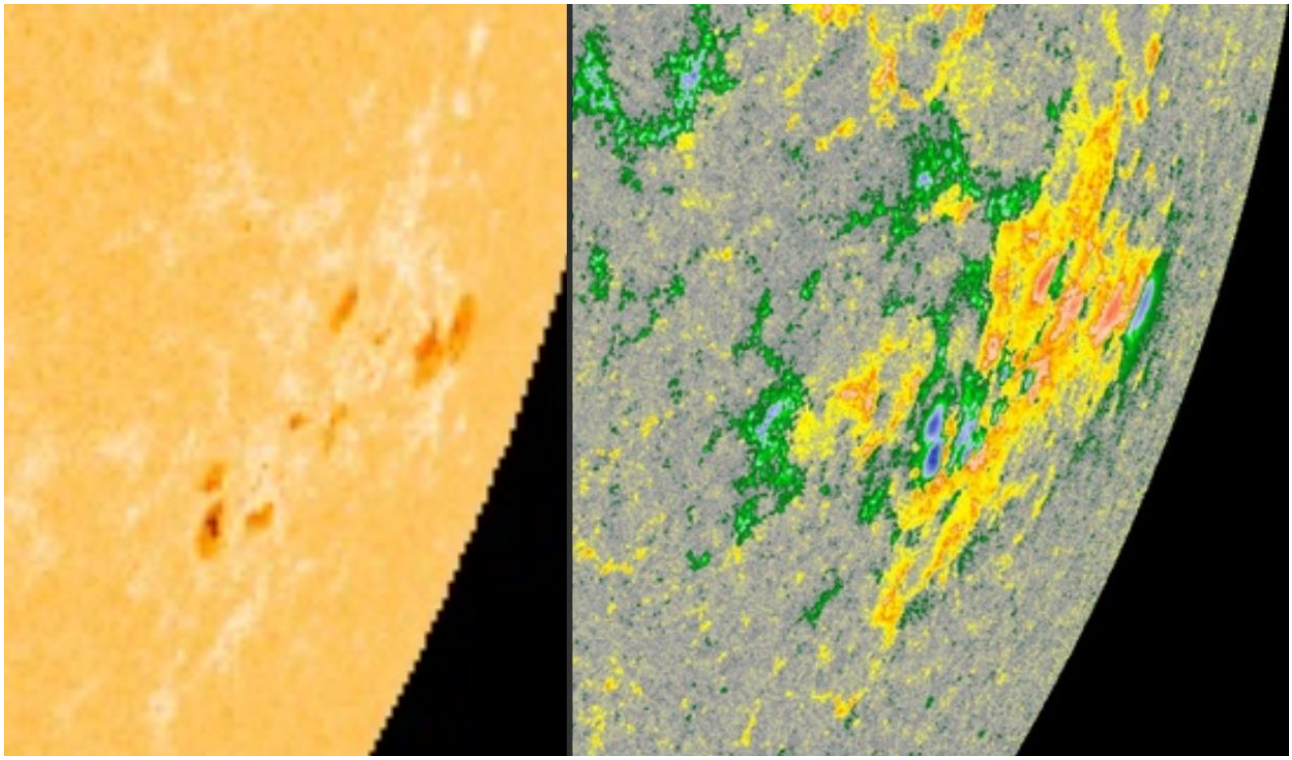

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Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux is currently at background levels. Any further notable flares will bring a risk of proton flux rising, especially if they occur close to the western limb. Overall, there is a continuing slight chance of reaching the S1/Minor Radiation Storm threshold. With the probability maintained as a number of regions depart, whilst others rotate onto or across the visible disc.

Please note: GOES18 is currently being used as the primary proton instrument, with GOES16 data currently viewed as unreliable due to a fault reported by NOAA.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

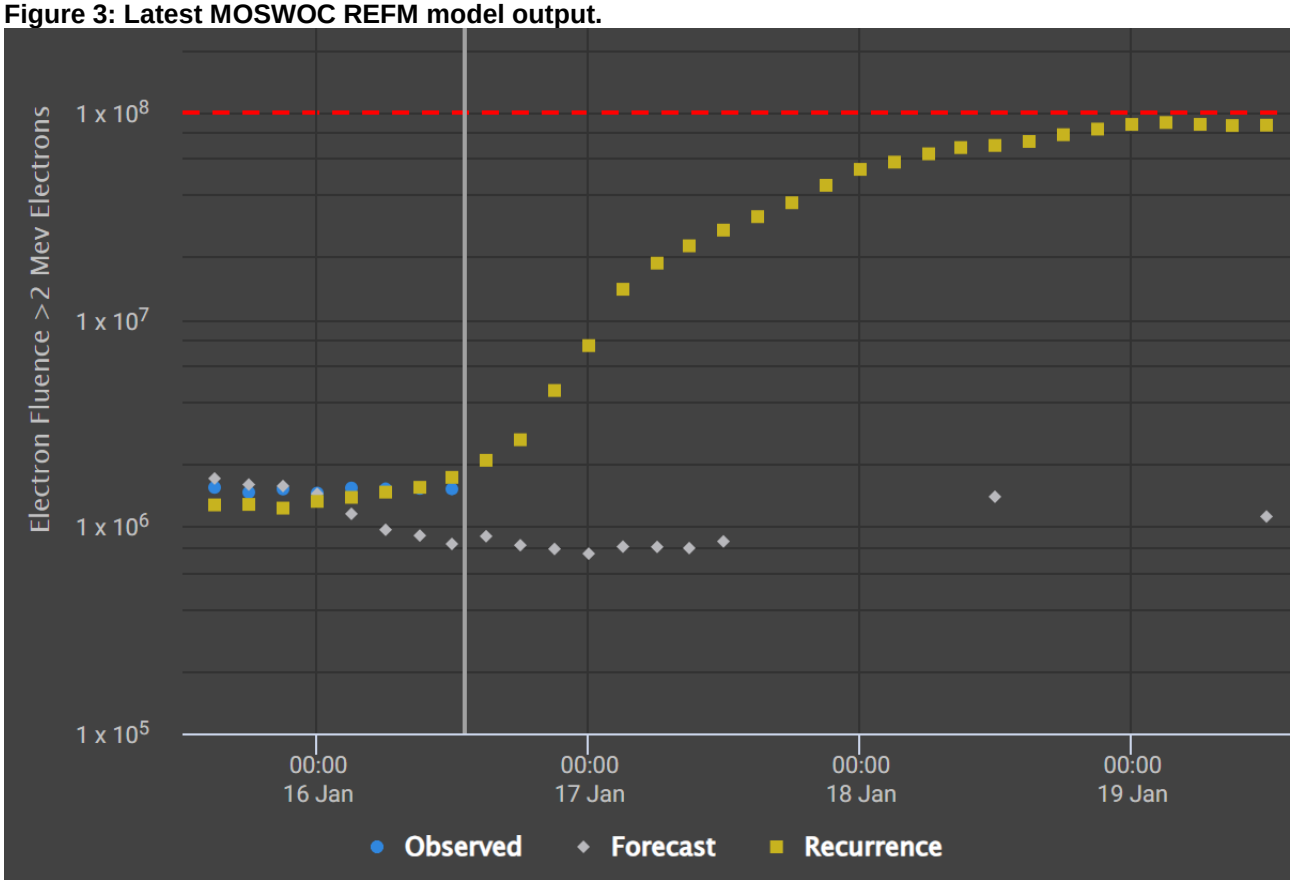
High energy electron flux (greater than 2MeV) as measured by GOES16 at GEO is currently at background to moderate levels, and in the absence of any significant enhancement is expected to persist around this level throughout much of the forecast period.

Connection to a coronal hole high speed stream may occur from late day 1 or day 2 (16-17 Jan), likely waning into day 4 (19 Jan) with any associated enhancement not expected to produce any significant electron response until day 4 at the earliest.

MOSWOC REFM forecast values maintains fluence well below Active throughout the period. This is considered reasonably good guidance. Recurrence would suggest fluence values may approach the Active level by the end of day 2 (17 Jan), however, the coronal hole is smaller and less pronounced and further east on this rotation so any enhancement is expected to be less significant and later than on the previous rotation.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: Latest MOSWOC REFM model output.



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